

# TMOD TECHNOLOGY/ENGINEERING TASK PROPOSAL

PROPOSAL TITLE: <b>Distributed Ground Data System Framework for Interoperable Space Missions</b>	
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ORGANIZATION: 3890	
TECHNOLOGY WORK AREA OR SSM: Science Processing and Information Management	
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## BRIEF TECHNICAL SUMMARY (*Objectives*)

Many NASA missions and projects produce large quantities of data, however, many have not integrated spacecraft and ground data management systems well. The objective of this task is to research, develop, and insert new data system technologies, that will provide the space/ground data system framework necessary to support interoperability between the spacecraft and ground system, in order to provide a close loop system that carries data from mission planning to data results.

## JUSTIFICATION AND BENEFITS

On-board data systems need more autonomy and data processing capabilities, while the ground data system needs to provide an infrastructure and tool-base that reduces the latency between an instrument event and a human scientific analysis of that event. In addition, NASA and JPL's charter for faster, better, cheaper missions means that plugging in new missions must be done efficiently to meet both schedule and budget requirements. This initiative will demonstrate the an architecture to put together a ground data system for a mission that integrates flight and ground systems, ground data management, mission planning, and support for plugging in new science tools as they are developed. This initiative looks at building a general model that can be specialized to support the data management needs of the future TMOD MDS mission profile.

## SPECIFIC MISSIONS OR CAPBILITIES TO BENEFIT

This activity shall support the MDS multi-mission Integrated Information Management (IIM) capability and provide a framework to support any mission or project, which adopts that infrastructure. The current list of missions signed up to use the MDS infrastructure include Europa Orbiter and ST4.

## PRODUCT TO WHICH THIS CONTRIBUTES

This task shall continue the on-board IIM development activities, but add a ground-based component. The framework thus created will tie together the necessary infrastructure to complete the end-to-end processing of data between the ground system and spacecraft. In addition, it shall provide data access APIs to the ground and flight based analysis tools in order to locate data within the environment.

## APPROACH AND PLAN

This activity shall provide the middleware capability that integrates flight system services, ground data management services, science analysis services and science planning. COT software will be used where appropriate and integrated into the framework. The activity shall use standard APIs and protocols where possible (including JDBC, ODBC, IIOP, etc) to limit the dependency on any one COTS vendor's implementation.

This task shall provide integration between the IIM Flight Data Management system and the ground data system. The CCSDS CIFP, if available, will be integrated into the IIM Onboard Data Management system and deployed as a service to allow the flight system to push data to the ground system as part of its transaction and event control. If CIFP is not available, a derivative of the existing ST1 protocol will be substituted. The service shall support metadata tagging to describe the products and contents. This software shall serve as a core component in establishing the framework and shall allow distributed clients both on the ground and in space the ability to move products between systems. Other science processing algorithms will be integrated as necessary. Client methods for this service shall be developed and provided to customers as a delivery for this task.

The ground data management services shall provide archive and catalog management, data access and mission profile information. It shall work with the data product manager service to archive products sent from the flight system. In addition, this task shall support the Flight IIM team to establish data models and storage algorithms which are mission and dataset independent. The concept is to provide the capability to manage and archive mission data (science, engineering, etc) using metadata definitions so that new mission instances and additional datasets can be integrated without having to rebuild new data models. The data access service component shall allow web-based applications and tools the ability to plug into and search mission instances and dataset information.

The middleware services that are developed shall continue to support components for science analysis onboard, but shall also facilitate ground based access to the reduced data. A goal of this activity will be to create web-based tools that can sit on top of this infrastructure, gain access using the data access service component, and then continue to analyze the data. The data analysis service will be an extensible service that will evolve as new analysis routines are developed. The range of services that can be incorporated are from data transformations and conversions to navigation. Services that are developed in the middleware shall be available as components to new and existing tools.

The fundamental activity for this year is demonstration of an integrated system with flight and ground components. This end-to-end demo shall include simulated instruments, onboard science processing, onboard data compression, integrated buffer management, simulated downlink, middleware functionality to move the data from the downlink to ground storage in a DBMS, and middleware support to move the data from the DBMS to a science application such as a data viewer. Specific activities shall include:

- 1) enhanced onboard science processing support through an API to the onboard data management system
- 2) integration of the latest science processing and buffer management modules
- 3) integration of existing middleware components
- 4) integration of a basic science application such as a web-based image viewer
- 5) translation and use of an existing Reference Mission as a guide to the demo environment

A second year activity will be to look at adding decision support and intelligent agent processing at the ground system and integrating that with mission operations in addition to documenting a specification of user-level protocols and APIs for data request/transfer between spacecraft and ground. Finally, this activity would like to look at correlating mission plans with results. This would allow scientists to look at phenomenology between their proposed plans with the actual data, and then re-propose new plans. The benefit would be that scientists could then compare hypotheses with results and then make new hypotheses. This also would be a good second year activity.

Finally, this effort will use real data from planetary and astrophysics missions to simulate interfaces and show how mission planning, spacecraft and ground system integration, and ground data management can close the loop to provide a coherent environment for conducting flight mission operations from conception to delivery.

## **DELIVERABLES**

### Utilization of a Reference Mission

- 1) Translation of MDS Reference Mission document into requirements for data management system

### Continued Support for IIM Service Integration

- 1) Demonstration of API integration with science processing and buffer management modules

### Product Management Service (February 2000)

- 1) Integration of middleware service

### Ground Data Management Service Created (April 2000)

#### 1) Integration of ground DBMS

Client Tools (August 2000)

- 1) Selection of demonstration application
- 2) Modification to provide a demonstration data request to be up-linked and responded to

End to End Demo (September 2001)

Continued Support for IIM Service Integration (FY 2001)

- 1) Delivery of documented API for accessing onboard data management services

Product Management Service (FY 2001)

- 1) Specification of user-level protocols for data requests/transfers

Mission Planning Interface (FY 2001)

- 1) Provide services to the mission planning tools.

Intelligent Agent Processing (FY 2001)

Data Analysis Capabilities (FY 2001)

## **PARTNERING**

In addition to continuing the support for IIM, this activity shall seek to partner and use services that are being developed by the Object Oriented Data Technologies task for the Interactive Analysis Program. This includes data management, archiving and retrieval services. In addition, we shall partner with the Interfered Processing and Analysis Center (IPAC) and the SeaWinds Processing and Analysis Center (SeaPAC) to share software used in support of SIRTf and the QuikSCAT/SeaWinds projects, respectively.

## **INFUSION PLAN**

This activity shall work closely with the TMOD and MDS engineering teams to be integrated into support for future JPL missions.

## **OTHER PERTINENT INFORMATION**

Considerable synergy can be obtained between this activity and the Object Oriented Data Technology activity, which designed and built the distributed ground system component using Java for the Palomar Testbed Interferometer. This information management system allows scientists to view data that is archived nightly using Java tools in the browser. Research and development work performed with that activity would directly benefit this proposal.